PROGRESS REPORTS

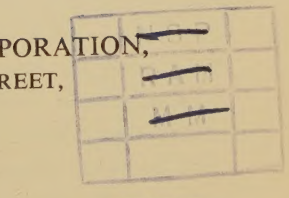
FROM

EXPERIMENT STATIONS

SEASON 1959-60

TANGANYIKA TERRITORY
COASTAL PROVINCES

PUBLISHED BY
THE EMPIRE COTTON GROWING CORPORATION,
12 CHANTREY HOUSE, ECCLESTON STREET,
LONDON, S.W.1.
EDITOR: H. E. KING, O.B.E.
1961



E.C.G.C. STAFF LIST

ILONGA

Plant	Breeding	...	...	R. Smith, B.Sc.
„	„	...	...	J. E. Cross, B.Sc., M.S.
„	„	...	...	T. Bradley, B.Sc. (*appointed 14.9.60*)

TANGANYIKA TERRITORY
COASTAL PROVINCES
PROGRESS REPORT FOR THE SEASON 1960

BY

R. SMITH, J. E. CROSS and T. BRADLEY

COTTON SEASON

Sowing: February to April.
Picking: July to November.
Close season: November to February.
Rainfall (Ilonga): December to June, 29·45 inches.

INTRODUCTION

Season and General

Although at Ilonga the total rainfall for the season was reasonably adequate, the distribution was poor. Rain in January enabled preparation of land to be completed. No useful rain fell in February and most trials were not sown until early March. In March and April it rained continuously, making weeding difficult. Too much water in the soil retarded growth in the lower parts of the experimental area.

The monthly totals in inches at Ilonga were as follows:

Dec. 1959	*Jan. 1960*	*Feb.*	*Mar.*	*April*	*May*	*June*	*July*
1·21	4·99	1·91	10·96	9·30	0·28	0·80	—

Through February, March and April jassid attack was heavy. Aphids also built up during this period, but were subsequently eliminated by the use of BHC. A few pink bollworm were found throughout the season, mainly in the cotton sown early in February.

American bollworm and spiny bollworm had appeared in considerable numbers by April. By early May many eggs had been laid by both species and populations were high throughout May. Infestation by American bollworm was diminishing by June, but the spiny bollworm attack remained at a high level throughout the rest of the season. *Calidea* and stainers (*Dysdercus* spp.) were early in the crop, being found in April. *Calidea* remained in large numbers until June. Stainers showed weekly fluctuations, but many were attacking bolls for the rest of the season. Routine insecticide applications controlled the insects, a tractor-mounted sprayer being used in bulk plots. Red spider mites appeared at harvest but did not affect yields.

Bacterial blight was widespread on seedlings, and stem and leaf infection was considerable on plots where a high water table reduced the rate of growth of plants. Elsewhere infection declined with the

onset of drier, cooler conditions, and the amount of boll infection was limited.

Selection and testing of improved varieties continued at Ilonga and district plot sites. Various combinations of improved strains mechanically mixed to form "multilines" showed advances in yield, ginning percentage and jassid resistance over Il58 at Ilonga. Work on the intrinsic ability of strains to withstand insect attack was continued. The pedigree material selected from Eastern Province Local has been reduced to three main family groups.

A study to assess the combining ability of the best selections was commenced in conjunction with measurements of the amount of outcrossing occurring. Testing of introduced bacterial blight resistant varieties was started. Variety trials were again planted in Northern and Tanga Provinces to find the best type of cotton for these areas.

It was again shown that throughout the coastal areas a worthwhile crop can be obtained only by the use of insecticide on well-tended, early-sown cotton. The results from a series of demonstration plots are set out in Table 1; these illustrate very well the extremely wide range in yields obtained at different standards of cultivation under the conditions prevailing this season.

TABLE 1

YIELDS OF SEED COTTON AT DIFFERENT LEVELS OF HUSBANDRY AT ILONGA IN 1960

Plot size 1/50 acre

Month of sowing	*Insecticide applications*	*Stand, spacing, thinning weeding*	*Yield lb per acre*
February	spray	Regular stand 3 ft × 1 ft thinned early to 1 pph, weeded frequently	1240
,,	dust		850
,,	none		333
March	spray		738
February	none	Irregular stand, wide spaced, late thinned, weeded once at end of rains	30

The proportion of viable seed obtained from cotton where no insecticide was used was much less than from cotton which had been sprayed with insecticide.

An increase in yield was obtained at a number of sites in Eastern Province when FYM, nitrogen and phosphate were applied to cotton. Cotton was again grown successfully at Rujewa trial irrigation farm, but results of a watering rate trial were inconclusive.

The Commercial Cotton Crop

Sowing in most areas of Eastern Province was late through lack of rain in February. Neither jassid attack nor bacterial blight damage was particularly severe, but insect attack in general was heavier this year than for several years past. Stainers entered the crop early in

most areas, reducing yields and increasing the proportion of grade III seed cotton.

In spite of an increase in the number of growers and the acreage sown, the total production of 14,000 bales only equalled last year's crop, mainly because of the above factors. The main spearhead for the development of insect control by insecticides is still in Bagamoyo district. Five hundred growers used sprays or dusts in the past season and it is expected that a thousand will in the coming season. In other districts users were few.

The Social Development Department is assisting the district agricultural officers in Bagamoyo, Morogoro, and Kilosa districts in a campaign to encourage insecticide use. They have prepared a series of visual aids, and are making films on the operations involved. Courses of instruction have been held for field assistants in technical and teaching methods. The scheme, designed primarily to encourage use of insecticides and thus raise farm incomes, is to include village community development and a literacy campaign. Apathy, lack of incentive and an inability to find the money to pay for it at the critical time are the main barriers to the widespread use of insecticide.

Co-operative buying was successfully started in some areas this year and is to be increased next year. Loans for insecticide can thus be made through an organised body able to collect the cost at the end of the season.

It is expected that sufficient seed of variety Il58 will be available for the whole province by 1962. The losses through insect attack are dramatically shown by the multiplication rate for Il58 seed during the past year. In Kilosa district, with a high level of husbandry but no insecticide, the increase (of grade A seed) was only threefold. Where insecticide was used on cotton in pure stand, on forty demonstration plots scattered throughout the district, the increase was twenty-four-fold—eight times greater. Seed for the coming season in Kilosa district is being dusted with Perecot to reduce primary bacterial blight infection.

More interest is being shown in cotton in Tanga and Northern Provinces and it is being sown in March (earlier than formerly). District trial plots showed that yields of seed cotton from 840 lb to 2,900 lb per acre can be obtained where good husbandry is practised and insecticide used. The range in conditions in these two provinces is great. It is feared that wide scale use of DDT in Northern Province might cause red spider mite to increase.

Plant Breeding

The aims of the breeding work remained as stated in previous reports, the main programme being reselection and testing within Eastern Province Local material. Work is now confined to three

main families, 51/77, 51/111 and 48/64. Much variation still exists within these families, but their general characteristics are shown in Table 2.

TABLE 2

GENERAL CLASSIFICATION OF SELECTIONS FROM THE MAIN FAMILIES IN RELATION TO IL58

Family	*Jassid resistance*	*Gin %*	*Yield*	*Lint quality*
51/77	Equal	Slightly better	Better	Better
51/111	Better	Better	Better	Equal
48/64	Equal	Better	Better	Equal

A trial of 100 selections made between 1954 and 1958 (arranged as a triple lattice repeated three times) gave increases in yield, compared with Il58 as control, of up to 42%. Ginning percentages ranged from 32·0% to 35·7% (with Il58 at 31·7%). Lint indices were generally higher than control. Records of mean maturity date showed several strains to be five days earlier than Il58.

Amongst the 1959 selections grown in observation plots, ginning percentages ranged from 32 to 40. Discarding within these selections was for jassid susceptibility.

A further 2,000 single plant selections were taken this season from all strains grown, the criterion for selection being resistance to jassid. Of these, 1,600 were discarded after obtaining combed lint length, ginning percentage and lint index, and examining these and the parental performance records.

Selection Index

Although most selections are now grouped into relatively uniform families, variability within these families remains high and straight selection is still the main method for producing improved types.

However, the selection index technique is being continued as a further available tool, its use for the present being to show which of the components of yield are contributing to the selection advance and which plant type is producing the best results.

This year the index again selected progeny with many bolls per plant, few seeds per boll and much lint per seed.

Multiline Strains

Twelve selections which have been tested over several years and have shown improvements over Il58 were mechanically mixed in various proportions and combinations to constitute eight mixtures or multilines for testing as possible commercial issues. The 12 selections all had several "good" selection characters and one or two in different characters. Also they have shown different yielding abilities at

different district plot sites. The mixtures were made to even out place effects and to compensate for individual indifferent selection characters.

This system allows more latitude in the synthesis of a commercial issue with a better combination of characters than is contained in the single strains at present available. It is also hoped that the system will exploit the phenomenon of hybrid vigour in later generations when crossing has occurred between the mixed strains.

The results obtained from the variety trial conducted at Ilonga are shown in Table 3. The increases over Il58, in lint yield, ginning percentage and lint index, shown by every one of the multiline strains, are impressive and their jassid resistance is in general rather better.

TABLE 3

RESULTS FROM A MULTILINE VARIETY TRIAL AT ILONGA, 1960

3 × 3 balanced lattice, 4 replications. Routine insecticide spray

Plot size 1/145 acre

Strain	*Lint yield*		*Gin %*	*Lint index*	*Jasid grading*
	lb per acre	*as per cent of Il58*			
A	279	119	32·4	4·1	2·75
B	275	117	33·6	4·2	2·88
C	296	126	33·0	4·3	2·50
D	292	124	34·6	4·6	2·00
E	301	128	34·7	4·4	2·25
F	310	132	33·0	4·3	2·00
G	291	124	33·9	4·3	2·63
H	278	118	34·0	4·0	2·38
Il58	235	100	31·6	3·9	2·50
S.E.	± 21	± 9			

Jassid grades: 1 very good; 4 very poor.

As a corollary to the work on multilines, reciprocal crosses were made of the constituent strains in all possible combinations so that eventually the combining ability of the individual strains can be measured and the degree of hybrid vigour estimated.

Also, a preliminary study of the amount of cross-pollination occurring was commenced. An imported red leaf cotton from Uganda was used as the marker. Indications are that where insecticide is used the amount of outcrossing is inversely proportional to the distance from the red-leafed plants. Where there is no insect control, cross-pollination appears to be at random. About 5% crossing occurred this season between small adjacent plots where insecticide was not used.

District Plots, Eastern Province

Comprehensive information on the better selections made between 1954 and 1957 was provided by the results of the district variety trials. Cotton is grown in a number of widely separated areas in Eastern

Province differing amongst themselves and from Ilonga, where growing conditions are usually very good.

Variety trials were sown at eight locations in Eastern Province. Four separate trials were sown at each site, three in February and one in March. Of the three February sown trials, one received routine spray insecticide, one received routine dust insecticide, and the third was not protected against insect attack. The March sowing received no insecticide, the potential yield being too low to bear the cost. In each trial sixteen strains were compared in a balanced lattice design with five replications in plots of 1/484 acre, spaced at 3 ft × 1 ft and thinned to one plant per hole.

Most of the trials were sown at the right time and received adequate rainfall. Consequently the yields of the sprayed plots (given in Table 4) were high; two trials gave over 600 lb of lint per acre. Bollworm attacks, however, were heavy and stainers were present throughout the season at all places; the much lower yields of the unsprayed plots (summarised in Table 5) reflected the heavy damage caused by these pests.

The lint yields given by the sixteen strains in the sprayed trials only are set out site by site for six of the sites in Table 4 as percentages of Il58. In Table 5 are given the means over all six sites for each of the four treatments—February sown, sprayed, dusted and no insecticide; and March sown, no insecticide—again as percentages of the yield of Il58.

TABLE 4

EASTERN PROVINCE VARIETY TRIALS, 1960

YIELDS OF LINT IN SPRAYED TRIALS ONLY AT SIX SEPARATE SITES

Strain yields expressed as percentages of yield of Il58

Strain	*Ilonga*	*Kiberege*	*Kisaki*	*Mikese*	*Miono 1*	*Miono 2*	*Mean*
54/155	118	101	85	98	84	103	98
218	133	119	98	110	118	105	114
275	123	116	101	136	141	109	121
295	104	109	97	121	106	107	107
55/14	128	100	89	95	97	90	100
106	119	116	97	110	103	100	108
56/7	185	122	114	137	107	98	127
86	122	92	88	107	102	95	101
89	137	114	95	113	100	94	109
97	142	94	96	115	97	105	108
161	115	109	88	120	101	96	105
162	120	107	94	88	107	94	102
182	108	92	99	95	112	89	99
57/116	126	128	104	134	114	110	119
47/10	61	61	67	85	113	81	78
Il58	100	100	100	100	100	100	100
S.E.	±11	± 7	± 5	± 7	± 7	± 6	—
Mean lint yield lb per acre	359	603	645	579	586	409	—

TABLE 5

EASTERN PROVINCE VARIETY TRIALS, 1960

YIELDS OF LINT AT DIFFERENT LEVELS OF INSECT ATTACK AND AT TWO DATES OF SOWING

Means over six sites as percentages of yield of Il58

Strain	*February sown*			*March sown*	*Mean Gin %*
	Sprayed	*Dusted*	*No insecticide*	*No insecticide*	
54/155	98	97	93	102	32·8
218	114	112	110	112	33·1
275	121	127	116	124	33·2
295	107	110	102	119	33·1
55/14	100	108	100	113	33·0
106	108	111	98	118	33·0
56/7	127	124	122	125	36·7
86	101	113	95	114	31·9
89	109	115	102	103	32·6
97	108	109	107	121	33·3
161	105	112	94	103	33·0
162	102	106	92	120	33·5
182	99	95	88	124	32·3
57/116	119	125	122	122	34·9
47/10	78	75	66	100	30·7
Il58	100	100	100	100	32·3
Mean lint yield lb per acre	530	453	244	116	—

From these tables the consistent advances shown by certain of the strains can be seen. Strains 56/7 and 57/116, for instance, did well at almost every site and under each treatment. Further details of the performance of these two strains and of eight of the others are given in Table 6. From these it can be seen that there is variation in most characters within as well as between the main families. Diversification within family 48/64 is particularly noticeable. Strain 56/7, and the selections from it, have been taken out of the main programme. They have shorter, coarser lint and will be of value if a type of this description is ever required.

In these district trials no consistent differences occurred between or within families in the reaction to protection by insecticides; those obvious differences which did occur in particular instances could not be related to any specific field character such as plant habit.

In a trial at Ilonga, however, quite large differences were recorded. These are set out in Table 7, from which it can be seen that strains 58/567 and UPA behaved very differently from strains 56/618 and 58/1138. Strain 58/561 gave consistent increases over Il58 irrespective of protection by insecticides.

Trials in Tanga and Northern Provinces

Trials of imported and local varieties were sown at five sites in Tanga and Northern Provinces. These sites covered a distance of 250 miles and a very wide variation in rainfall and soil. At two sites

TABLE 6

EASTERN PROVINCE VARIETY TRIALS, 1960

MEAN VALUES FROM SIX FEBRUARY SOWN SPRAYED TRIALS

FOR VARIOUS CHARACTERS OF STRAINS WITHIN THREE MAIN FAMILIES

Family	*Strain*	*Yield of seed cotton (lb per acre)*	*Gin %*	*Yield of lint (lb per acre)*	*Lint yield as % Il58*	*Lint length (1/32 inch)*	*Lint index*	*Jassid grade**
48/64	54/218	1707	33·1	568	112	37·5	4·2	2·0
	56/7	1692	36·7	623	122	32·6	4·8	1·6
	57/116	1715	34·9	601	118	34·9	4·6	1·6
51/77	54/275	1835	33·2	609	120	37·4	4·1	1·8
	56/86	1568	31·9	502	99	37·7	3·8	2·0
	56/89	1650	32·6	540	106	37·4	4·0	1·8
51/111	56/97	1594	33·3	531	104	37·4	4·2	2·0
	56/161	1582	33·0	525	103	38·1	4·1	1·8
	56/162	1514	33·5	508	100	37·3	4·3	2·0
	47/10	1297	30·7	399	78	37·2	3·8	3·0
	Il58	1557	32·3	507	100	37·1	4·1	1·8
Mean		1610	33·2	538	106	36·8	4·2	1·9

*Grade for resistance to jassid: 1 indicates very good, 4 very poor.

TABLE 7

TRIAL AT ILONGA OF STRAINS OF 54/58 GROWN WITH AND WITHOUT INSECTICIDE

Lint yields expressed as percentage of Il58

Strain	*No insecticide*	*Spray insecticide*	*Dust insecticide*
58/567	84	129	144
UPA	99	135	129
58/618	213	123	141
58/1138	161	92	118
58/561	130	127	126

the rainfall was supplemented by some irrigation. At each site there were three trials, one unprotected from insects, one sprayed and one dusted with insecticide.

No conclusive evidence was provided by these trials as to whether Namulonge, Ukiriguru or Ilonga is the best source of seed for these areas. Most strains from each source did better than the "local" BP52, but one from each gave a lower yield. The average yields of the trials which were sprayed or dusted were substantially higher than those of the unprotected trials.

Comparisons of Seed from Various Ginnery Zones

At Ilonga a trial was conducted to test the performance of 47/10 seed taken from a number of ginneries in Eastern Province under uniform conditions. Complaints of deterioration of seed had been received and the possibility exists that local selection pressure may have altered the original genetical population considerably in the different growing areas. The results are confused as some mixing of 47/10 with Eastern Province Local occurred during the multiplication period, but from Table 8 it will be seen that there is no evidence that change has occurred. The most notable feature of the trial was the considerable improvement shown by Il58 over 47/10.

TABLE 8

RESULTS OF A COMPARISON AT ILONGA OF SEED OF STRAIN 47/10 FROM EIGHT GINNERY ZONES IN EASTERN PROVINCE

Eight randomised blocks, plot size 1/242 acre

Sown 2nd March 1960, given routine insecticide sprayings

Ginnery zone	*Seed cotton yield (lb per acre)*	*Ginning percentage*	*Lint yield (lb per acre)*	*Lint yield as % of Il58*
Kilosa	469	31·6	148	58
Rudewa	491	31·1	153	60
Msowero	567	30·8	175	69
Morogoro	503	32·2	162	64
Ngerengere	463	31·1	144	57
Mandera	453	32·3	140	55
Duthumi	431	32·2	139	55
Msomeni	535	31·4	168	66
S.E.	± 49	—	± 15	± 6
Means for strain 47/10	486	31·6	154	60
Il58	777	32·7	254	100

Bacterial Blight, Investigations and Breeding for Resistance

Estimation of losses due to bacterial blight is difficult because of insect attack—especially at the boll stage. In visits to twenty-eight shambas between March and April it was found that 42% of the plants had angular leaf spot, 14% had stem lesions and 11% had petiole infection. The symptoms were most prevalent in late planted gardens which had been cultivated for a number of years.

The seed dressing trial which was conducted in 1959 was repeated. The effectiveness of mercurial seed dressings in reducing primary infection was again demonstrated.

Varieties resistant to bacterial blight have been introduced from Ukiriguru, Nyasaland and Nigeria. These varieties have been screened for resistance using inoculum from diseased leaves. The susceptible segregates have been discarded. Most of the varieties showed good jassid resistance, but were more vegetative and later maturing than the Ilonga material. Two families from Ukiriguru gave lint quality up to the required standard. Variety trial results showed that some introductions yielded as well as the Ilonga material and also gave ginning percentages up to 38%.

Two hundred single plant selections for resistance were made this year.

Entomology

In the absence of an entomologist no formal studies of insect pests were made, but the level of attack by the main pests was recorded. Important points from these records have been given in the introduction.

The very extensive investigation of the effects of control measures, both spraying and dusting, were combined with the plant breeding work and the main results therefore appear in the tables already presented.

From Table 5 it can be seen that spraying was more effective than dusting, that either gave a spectacular increase over no insecticide and that when sowing was delayed until March and no insecticide was used very low yields were obtained.

In addition to the striking increase in yield obtained with insecticide applications, the grade of the seed cotton was very definitely improved. With February sowing and either spraying or dusting, about 65% of the produce was grade I. February sowing, but no insecticide, gave on average 46%; March sowing without use of insecticide gave on average only 34% grade I.

The production of as much grade I seed cotton as possible is important; the prices for the two grades this season were 51 and 19 cents per lb.

There was also a marked difference in the viability of the seed harvested from protected and unprotected plots. The germination percentage of seed from plants unprotected from insect damage was on average no higher than 33% compared with 50% for seed from sprayed plots.

Agronomy

Permanent Fertility Trials

Replicated trials were sown at three sites, Majiliwa and Kilangali in Kilosa district and Kingolwira in Morogoro district. Phosphate and FYM were applied at sowing and nitrogen, as sulphate of ammonia, was applied to the phosphate plots at flowering. The Majiliwa and Kilangali gardens have been cultivated for a number of years. At Majiliwa, soil water was probably a limiting factor. Rainfall was negligible at Kingolwira and the trial was not analysed, because of the very low yield of seed cotton. The results at Majiliwa and Kilangali are shown in Table 9. Increases in yield due to fertilisers and FYM were small at Majiliwa but high at Kilangali. The control yield at Kilangali was surprisingly high as this garden had been left by its owner the previous year as it was considered to be "worn-out".

Table 9

Permanent fertility trials at two sites, 1960

Particulars of experiments

Majiliwa: sown 3rd March, five randomised blocks, plots 1/151 acre.
Kilangali: sown 6-12th Feb., six randomised blocks, plots 1/134 acre.
Manurial treatments: FYM = farmyard manure at 5 tons per acre.
Fertilizer = triple superphosphate and sulphate of ammonia each at 1 cwt per acre.

Yields of seed cotton

Treatments	*Majiliwa*		*Kilangali*	
	lb per acre	*per cent control*	*lb per acre*	*per cent control*
FYM	514	110	2505	180
Fertilizer	517	110	1853	134
Control (no manure)	469	100	1396	100
S.E.	± 31	± 7	± 239	± 17

Fertiliser Observation Plots in Eastern Province

If insecticide use and better husbandry become more widely practised, yields per acre will increase. These larger yields may lower the nutrient status of the soil and it is well to evaluate fertiliser responses throughout Eastern Province. This season, fertiliser has been applied to 30 native gardens in 6 areas in the vicinity of the district variety trials. On 29 of the gardens the yields from plots where fertilizer was applied exceeded those of the controls. Some plots received insecticide, some did not. Triple superphosphate was applied

at 100 lb per acre at sowing and sulphate of ammonia was applied at 100 lb per acre at flowering. The indications from these trials are that increases in yield can be obtained by the use of phosphate and nitrogen in most areas.

Irrigation Trials

Further trials of cotton grown under irrigation were carried out at Rujewa. In one, which received routine insecticide treatment to control American and spiny bollworms, stainers and *Calidea,* the yield over five acres was 1,067 lb per acre in spite of sowing difficulties and rat damage. In another there was an indication of a 20% increase in yield compared with raingrown cotton in spite of the higher than normal rainfall (33 inches against a mean of 23·36).

Appendix

Summary of strains

Eastern Province Local	The original commercial cotton in the Province, mainly of Uganda Local origin. Strains prefixed by the figures 44-60 which denote the year of origin, are all selections or reselections from Local.
47/10	A selection from Local; the current commercial cotton of the Province.
Il58	A multiline issue composed of 7 strains with improved yield and ginning percentage. At present replacing 47/10 in Eastern Province.
Uk51	A multiline strain of cotton developed at Ukiriguru and currently grown in Handeni district of Tanga Province.
BP52	The present commercial cotton in Northern Province and parts of Tanga Province, having been imported from Uganda.
UPA L2/23 L3/30 NC58	Introduced varieties from Namulonge.
6/5 Uk51 Uk55 Uk58	Introduced varieties from Ukiriguru.
Multiline A to H	A series of multiline varieties from the twelve best Ilonga strains to date.

Routine insecticide treatments

Dust	10% DDT plus 3% BHC applied once a week at 10 lb per acre. Applied with Swaine dusters or rotary dusters at the onset of insect attack.
Spray	DDT (emulsion) at the rate of 1 lb DDT (in 10 gallons of water) per acre per week, plus ¼ lb BHC if required for control of aphid, using knapsack sprayers. Lower rates than 1 lb DDT give adequate, though less, control. Both applied weekly for eight weeks.

Received April 1961

PROGRESS REPORTS FROM EXPERIMENT STATIONS

The reports for the seasons up to and including 1950-51 were published in seasonal volumes; the following are still in print and available at 3/- per volume post free.

1923-25 (one volume), 1926-27, 1931-32, 1934-35,
1935-36, 1942-43 and 1945-46 to 1950-51.

From 1951-52 the reports from each territory were published individually each season. A few of the 1951-52 reports are out of print, but all others are available post free at 2/6 per report or £1 for the seasonal set.

T. BUNCLE AND CO. LTD., ARBROATH